ELEC 531: Statistical Signal Processing
elec531.rice.edu, TTh 1-2:15PM, Keck 101

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Graduate level course in statistical signal processing. Focuses on detection and estimation theory, and the relationships between them. Concentration on discrete-time results. Performance bounds derived from signal processing and information theoretic perspectives.
Prerequisites: Knowledge of random processes.

Course Outline

Foundations

- Definition of a random process in continuous- and discrete-time
- Second-order description: expected value, correlation function and power density spectrum
- Sampling processes
- Jointly defined processes: cross-correlation function, linear filtering
- Karhunen-Loève expansion
- Constrained and unconstrained optimization

Estimation theory

- Parameter estimation: mean-squared error, MAP, maximum likelihood
- Linear estimation
- Spectral estimation
- Adaptive filters
- Optimal filtering: Wiener, Kalman and Bayesian filters; denoising
- Compressive sensing

Detection theory

- Statistical hypothesis testing
- Sequential detection
- Detection of signals in noise
- Unknown parameters

Course Objectives

1. Develop provably optimal methods for processing stochastic signals;
2. Performance bounds for these methods;
3. Develop estimation and detection procedures for non-Gaussian as well as Gaussian signals;
4. Demonstrate the role and assumptions of modern approaches in machine learning;
5. Determine performance bounds that apply universally;
6. Illustrate signal processing methods by applying them to real datasets.

Required Text

Johnson, *ELEC531*, Course notes available at the course web site

Grading Policy

Grades are based on two take-home quizzes, the problem sets (usually weekly), and an oral final.

Problem set grades will be separately averaged and normalized to a 100 maximum, the grading standard for the quizzes and the final.

Syllabus Change Policy

This syllabus is only a guide for the course and is subject to change with advanced notice.